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TERMINAL MORAINES OBSERVED IN ERTS-1 PICTURES

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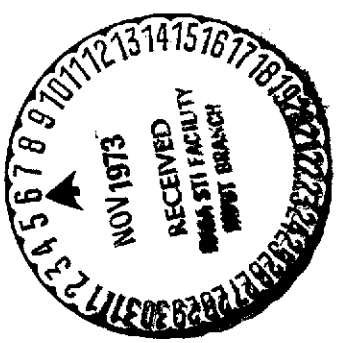

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ERTS-1

The American satellite ERTS-1 was launced into a circular and almost polar orbit a good 900 km above the earth's surface on 23 July 1972. ERTS-1 (Earth Resources Technology Satellite) completes an observation cycle in 18 days and then returns again to the same path over the earth's surface introducing a new observation cycle. /146*

Recording pictures of the earth's surface, which is the primary purpose of the satellite, is done with a multi-spectral scanner and a television system, which records in four, respectively three wavelength ranges. The picture information is transmitted by telemetry to receiver stations on the ground.

ERTS-pictures - a natural map

With corrections, which are introduced when the picture is formed, the pictures reach a high degree of cartographic accuracy. Stereo effects can normally not be obtained between pictures in the same path. The overlap is not adequate for this. However, the lateral overlap, which exists between two passes and which increases with increasing latitude, may give possibilities for a certain stereo effect. /147

The launching of the satellite was preceeded by an international offer to participate in the project, and in this case the picture crop from the first half year was probably

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* Numbers in the margin indicate pagination in the foreign text.

Fig. 1. ERTS-1 picture (0.5-0.6 μm) over the outer Oslo Fjord as well as part of the Swedish west coast (4 Sept. 1972). Approximate scale 1:1,250,000. Photo material NASA.

subjected to analysis in many countries and from widely different points of view, not in the least geological.

Terminal moraines near the Oslo Fjord and the Swedish west coast

In going through ERTS pictures from the point of view of identifying ice edge lines it was obvious how larger edge formations appear within certain areas. The ERTS picture, figure 1, centered on central Bohuslän at once gives a summary of the position of ice edges near the Oslo Fjord, in certain parts of Dalsland as well as in Bohuslän.

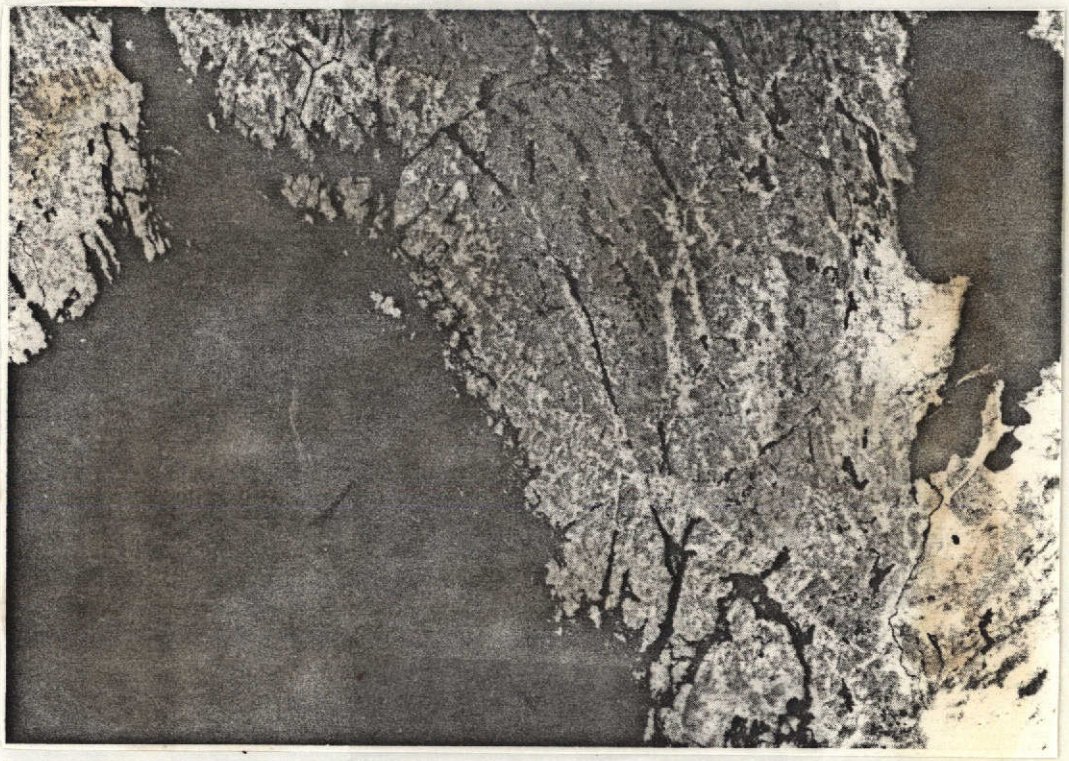

Fig. 2. ERTS-1 picture (0.7-0.8 µm) over the outer Oslo Fjord as well as part of the Swedish west coast (4 Sept. 1972). Approximate scale 1:1,250,000. Photo material NASA.

The Ra-line around the outer Oslo Fjord, which bends in to form a large estuary, gives the impression of an actual front line. The accentuation the position of the edge here gets in the ERTS pictures would probably be mainly a result of the utilization of the ground, which naturally in turn is based upon geologic and/or topographic reasons.

The picture, figure 1, is taken 4 September 1972. One knows extremely little about which season is the most suitable for obtaining quaternary geological and glacial geographical information. In addition, parameters such as ground moisture and local vegetation may be of great importance within a season. In

a satellite project of the type ERTS it is interesting that, with the repeated recording which takes place, material can be collected for comparison and evaluation of the importance of the external parameters for obtaining optimum information content. This may also be of value for other types of remote recording, e.g., conventional aerial photography.

Another side of the ERTS project, which gives the experiment greater scope, is the simultaneous picture recording in different spectral ranges. The multi-spectral scanner thus gives recording in the bands: 0.5-0.6 µm, 0.6-0.7 µm, 0.7-0.8 µm as well as 0.8-1.1 µm. Of these the last-mentioned correspond to two wavelength intervals in the IR range. Figure 2 is an example of a picture from one of the IR channels (0.7-0.8 µm) which as far as the fissure valley landscape is concerned gives clearer information than the band 0.5-0.6 µm (fig. 1). Fig. 2 also gives sharper accentuation of sea surfaces. It is obvious that the /148 seas stop at the Ra-line east of the Oslo Fjord. Haze is less of a hindrance for recording in the IR range than for the visible interval. The continuation of the Ra-line into Sweden does not appear in any clear grey shadow contrast (fig. 1). However, traces of a line can be distinguished in some places in the darker grey shade in the sea area in Dalsland. First closer to Vänern is there again a clear contrast accentuation for the continuation of the Ra-line in the central Swedish terminal moraine area.

Another edge formation, which is not as pronounced as the Ra-line, is the system inside Orust, which was first mapped by Björsjö (1949) and is considered by him to be part of the Göteborg moraine or "the large gothic west coast area". In Atlas over Sweden G. Lundqvist (1954) has indicated this line, diagonally through Bohuslän, as lying inside the so-called Göteborg moraine. In fig. 3, which is part of Mörner's map (Mörner 1969), selected here as outline map since it also includes

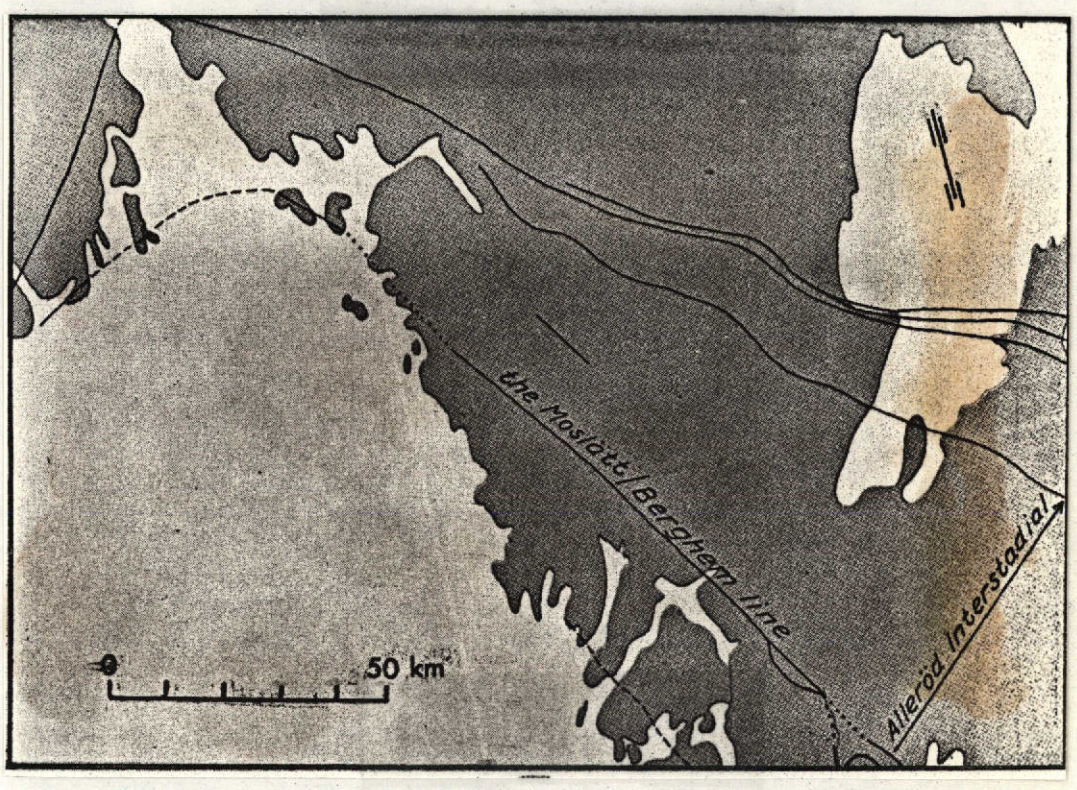

Fig. 3. Outline map over the area in figure 1 and 2 including moraine lines (Mörner 1969).

the part of Norway that is of interest, the edge formation is designated the Moslätt/Berghem line.

In the ERTS pictures this line is clearest on the inside of Orust, but after passing Byfjorden it can also be followed over the inner parts of Bokenäset to the inner Saltkälle Fjord (the Gullmars Fjord). After that the line can be detected only for shorter periods before it reaches the coast south of Strömstad. In this northern part there are indications of double lines for short sections. - A contributing cause for the appearance of the edge formations in the picture material is probably their nature as valley fill in the landscape through the supply of sediment.

ERTS-1, experiment with possibilities for application?

Earlier photography from satellites, primarily through the Gemini program, has shown that taking pictures from space could find application in many fields if only satisfactory resolution was obtained. By its nature, however, even the ERTS project is an experiment for finding out about applications of picture recording from space platforms.

From the evaluation of the picture material, which is now being carried out at various places in the world, it has been mentioned, for instance, that the ERTS pictures for certain parts of the earth's surface constitute the first useful material for a modern geological survey mapping. In other areas again, where good geological maps are available, the ERTS pictures will probably be more of a study material for investigating known geographic or geologic phenomena. However, the interesting /149 thing may then happen that new elements are encountered. This was witnessed in a number of lectures at a symposium in Washington in March 1973. This generally pertains to the geological alignment which had earlier been neglected or could not be observed for various reasons. Examples were cited, e.g., from apparently well investigated areas such as the Alps and the State of New York.

Next year should result in clarification of whether the expectations which have been associated with ERTS from a geological point of view will be met.

REFERENCES

N. Björsjö, Ice edge studies in southern Bohusläns. (Israndstudier in södra Bohusläns). S.G.U. Ser. C. No. 504, 1949.

G. Lundqvist, Channels, terminal morain and ice recession lines. (Räfflor, ändmoräner och isrecessionlinjer). Atlas of Sweden (Atlas över Sverige), pp. 21-22.

N. A. Mörner, The late quaternary history of the Kattegat sea and the Swedish west coast. S.G.U. Ser. C., No. 640.

Abstract

The ERTS-1 experiment is briefly presented. Based on ERTS images of the southwestern part of Sweden and the adjacent coast areaof Norway the detection of terminal moraines from the deglaciation period of the last glaciation is discussed. The moraine line of the Ra-substage (Younger Dryas) is especially very distinctly observable.